

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images,
please do not report the images to the
Image Problem Mailbox.

THIS PAGE BLANK (USPTO)

PCTWORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : H01L 31/16		A1	(11) International Publication Number: WO 99/63601 (43) International Publication Date: 9 December 1999 (09.12.99)
(21) International Application Number: PCT/GB99/01725 (22) International Filing Date: 2 June 1999 (02.06.99) (30) Priority Data: 9811708.8 2 June 1998 (02.06.98) GB		(81) Designated States: AE, AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
(71)(72) Applicant and Inventor: CONNER, Stephen, Joseph, Charles [GB/GB]; 9 Winton Drive, Glasgow G12 0PZ (GB). (74) Agent: BUTLER, Michael, John; Frank B. Dehn & Co., 179 Queen Victoria Street, London EC4V 4EL (GB).		Published <i>With international search report.</i>	
(54) Title: OPTICAL POTENTIOMETER			
(57) Abstract			
<p>An optical potentiometer comprises a base (7), a longitudinally extending support (4) provided on the base, a slider (2) mounted on the support for longitudinal movement, a control member (16) on an outer lateral edge of the slider, the inner lateral edge (13) of the slider being solid and tapering in the longitudinal direction, a light source (LD1) on one side of the slider adjacent the inner lateral edge, and light detecting means (D1) aligned with the light source and on the other side of the slider, so that longitudinal movement of the slider under the action of the control member selectively controls the amount of light reaching the light detecting means from the light source. Optionally second light detecting means (D2) is positioned on the one side of the slider to receive light from the light source (LD1) without the intervention of the slider (2), and compensating means are provided to control the output of the light source in accordance with a signal from the second light detecting means, using negative feedback.</p>			

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		

OPTICAL POTENTIOMETER

This invention relates to an optical potentiometer,
5 in which movement of a control member is used to vary
electric voltage or current. Such potentiometers may be
used to control light or audio output, for example.

A conventional type of potentiometer consists of a
movable electrical contact which bears upon a resistive
10 element. When such a potentiometer is subject to
repetitive displacement, the resistive element and / or
the movable element can be damaged by wear. This may be
aggravated by dirt or other foreign bodies entering the
potentiometer. A relatively small amount of wear or
15 contamination can lead to erratic performance and this
may render the potentiometer unusable. Potentiometers,
frequently operated by a sliding control member, are
often used to control lights or audio output in
discotheques and similar situations, where they can be
20 subject to very heavy use with rapid adjustments being
made. This leads to rapid wear.

In United States Patent 3,859,617 there is
disclosed a contactless, optical potentiometer. A light
source and a photoconductive cell are separated by a
25 rotatable disc which is provided with a slot which is
aligned with the light source and the photoconductive
cell. The cross section of the slot increases along an
arc so that as the disc is rotated the amount of light
reaching the photoconductive cell may be varied. In this
30 manner the resistance of the cell may be altered in
accordance with the rotational position of the disc.
However, rotationally controlled potentiometers are not
optimal for all uses, and particularly the control of
light and audio in discotheques and similar situations
35 as mentioned above.

In United States Patent 4,523,090 there is
disclosed a linear optical potentiometer. A light

- 2 -

emitting diode and a photodiode sensor are mounted at opposite ends of a housing but are not in direct alignment, being vertically offset so that the sensor can be exposed only to part of a cone of light from the 5 light source. A linear control member has a light blocking portion which moves longitudinally towards and away from the sensor, and as it does so it progressively obstructs more or less of the cone of light being emitted by the diode which can reach the sensor.

10 However, the design requires considerable separation of the light source and sensor and lends itself to limited design variations. The light blocking portion simply moves between a position in which the sensor is fully blocked, and one where it is not. To vary the rate of 15 adjustment requires increasing or reducing the distance between the light source and sensor and that requires constructing a new potentiometer with different dimensions.

United States Patent 4,796,000 discloses, in one 20 embodiment, a linearly controlled optical potentiometer. Once again there are disclosed a light source and a light sensor at opposite ends of an elongate housing, and in this case they are laterally offset so as to be either side of a film separating them. This film has 25 varying light transmitting characteristics along its length. A pair of movable reflectors are positioned one each side of the film, and are connected to a longitudinally movable slide control. Light from the source passes to one reflector, is rotated through a 30 right angle, is then passed through the film to the other reflector, is rotated through a right angle again, and then passes to the sensor. The position of the slide control and reflectors determines which part of the film 35 the light passes through, and thus how much light is transmitted. This is a complex arrangement.

According to one aspect of the present invention there is provided an optical potentiometer comprising a

- 3 -

light source, a light detecting means, a linearly movable control member, and light blocking means disposed between the light source and light detecting means which is movable to selectively determine the amount of light from the source which is received by the light detecting means, the position of the light blocking means being controlled by the linearly movable control member, characterised in that the light blocking means moves transversely with respect to the path of light from the light source to the light detecting means and has an operative edge which is profiled to adjust the amount of light passing from the light source to the light detecting means in accordance with the transverse position of the light blocking means.

This provides a simple and effective arrangement for a linearly controlled optical potentiometer. The operative edge may be a confined edge defined by a slot. For example there could be a triangular or other shaped slot in a solid plate serving as the light blocking means. Preferably, however, the operative edge is a free edge of the light blocking means. In the preferred embodiment there is a single operative edge, although it would be possible to have a pair of edges. Such a pair of edges would normally meet, notionally or in fact, at a point on a transverse line which passes through the central axis of the light path from the source to the detecting means so that the light is blocked and unblocked on two sides simultaneously. Thus, the light blocking means could take the form of e.g. a solid plate with an isosceles triangular aperture with both long sides being operative; or a plate which is in the form of an isosceles triangle with both long sides being operative. In the preferred embodiment there is a plate with a single edge and the light blocking means progressively blocks or unblocks the light from one side only.

The operative edge may be of any desired profile to

- 4 -

provide the desired effect. In a simple arrangement it will be purely linear with a constant angle with respect to the direction of movement. However, there could be changes in angle or the profile could be curved, at 5 least in part. Changing the profile of the edge of the light blocking means is a simple way of designing the potentiometer to have different characteristics.

In a preferred form of an optical potentiometer according to the invention, there is provided a base, a 10 longitudinally extending support provided on the base, a slider mounted on the support for longitudinal movement, a control member on an outer lateral edge of the slider, the inner lateral edge of the slider being opaque and tapering in the longitudinal direction, a light source 15 on one side of the slider adjacent the inner lateral edge and light detecting means aligned with the light source and on the other side of the slider, so that longitudinal movement of the slider under the action of the control member selectively controls the amount of 20 light reaching the light detecting means from the light source.

Preferably the light source, light detecting means and light blocking means are within a light proof housing, to prevent interference from extraneous light.

25 In a practical arrangement the output of the light detecting means of an optical potentiometer in accordance with the invention will be fed to signal processing means where its output can be converted to a form suitable for whatever application the potentiometer 30 is to be used in, such as one or more voltages or currents. For example, the output could be used to control audio signals. In one embodiment it could be processed to achieve cross fading between two mono or stereo audio signals. This could be achieved using two 35 or more voltage controlled amplifiers. Non-linear amplifiers may be used to provide a desired variation of audio volume in accordance with the position of a

- 5 -

slider. The potentiometer may be part of an audio mixing unit, for example of the type used by disc jockeys in discotheques, producers in broadcast or recording studios, and other similar situations.

5 The light source in a preferred embodiment is a light emitting diode, and the light detecting means may for example be a silicon photodiode or a phototransistor. One problem with light sources such as light emitting diodes is that there may be fluctuations 10 in output, for example as a result of temperature variations. This would cause unwanted variations in signal level. To compensate for this, in a preferred embodiment of the present invention there is provided second light detecting means which samples the output of 15 the light source and adjusts the output by means of negative feedback so as to maintain it substantially constant. Preferably the second light detecting means is identical to the first light detecting means so as to ensure that there will not be variations through 20 differential fluctuations of the characteristics of the light detecting means.

25 The compensation arrangement will be of use in various types of optical potentiometer, and thus viewed from another aspect the present invention provides an optical potentiometer comprising a light source, first light detecting means, a movable control member, and light blocking means disposed between the light source and the first light detecting means which selectively determines the amount of light from the source which is 30 received by the first light detecting means in accordance with the position of the movable control member, characterised in that there is provided second light detecting means arranged to detect light from the light source without the intervention of the light 35 blocking means, and compensating means which maintains the output of the light source substantially stable in accordance with a signal provided by the second light

- 6 -

detecting means.

Such an arrangement can be used with a slider controlled potentiometer as discussed earlier or with a rotary control. In such an arrangement the light 5 blocking means could be in the form of a rotatable plate with a tapering slot.

A preferred embodiment of the present invention will now be described by way of example only, with reference to the accompanying drawings in which:

10 Figure 1 is a side elevation view of an optical potentiometer unit in accordance with the invention;

Figure 2 is a plan view of the optical potentiometer unit;

15 Figure 3 illustrates the operation of the optical potentiometer showing the output from the optical photodiode with the photo resistant interruptor in a series of positions;

20 Figure 4 is a block diagram showing the use of feedback from the compensating photodiode D2 to control the output from the light emitting diode;

Figure 5 is a circuit diagram of the optical potentiometer; and

25 Figure 6 is a graph showing the simulated transfer characteristic of the processing circuit.

As shown in Figure 1 the optical potentiometer 30 comprises a light emitting diode LD1, a photodiode D1, a compensating photodiode D2 located in an optical mounting bracket 1, and a photo resistant interruptor 2 mounted on a movable table 3 comprising a frame 4 and a linear bearing 5.

35 A spacer channel 6 of constant section is formed parallel to base plate 7 in surface 8 of the optical mounting bracket 1. A secondary channel 9, formed in the optical mounting bracket 1 perpendicular to the base plate 7 intersects the spacer channel 6. A light emitting diode LD1 is mounted at the upper end of channel 9 with the light emitting surface S1 oriented

- 7 -

5 towards the spacer channel 6. A channel 10, corresponding to channel 9, is formed in the base plate 7 to facilitate the mounting of photodiode D1 at the lower end of channel 9 with the photoreceptive surface S3 oriented towards spacer channel 6.

10 A channel 11 is formed perpendicular to, and opening onto, channel 9 to facilitate the mounting of compensating photodiode D2 with the photoreceptive surface S2 oriented towards the light emitting surface S1 of the LED LD1. The sensing and compensating photodiodes D1 and D2 are both of exactly the same type to ensure consistent operation of the optical 15 potentiometer regardless of factors, such as temperature or aging, which may alter performance.

15 The linear bearing frame 4 is fixed to the base plate 7. The movable table 3 is attached to frame 4 by means of a linear bearing 5, as known in the art. The motion of table 3 is contained within a single axis 12 parallel to both the surface 8 of the optical mounting 20 bracket 1 and the base plate 7. The photo resistive interruptor 2, as shown in Figure 2, is in the form of an opaque plate and is provided on its outer edge with an operating control 16 so that it may be moved by hand. On its inner edge it is formed as an interrupting edge 25 13 which is oriented at an angle to an axis of motion 12 of the movable table 3. The interruptor 2 is fixed to the upper surface of the movable table 3 such that interrupting edge 13 is positioned between the light emitting surface S1 and the photoreceptive surface S3 of 30 the LED LD1 and photodiode D1, respectively.

35 In operation the interruptor 2 is moved in either direction along the axis 12, as shown in Figs. 3a-c, and the position of the interrupting edge 13 relative to the LED LD1 and photodiode D1 varies accordingly so as to cover the emitting surface S1 of the LED LD1 to a degree dependent on its position. This affects the amount of light falling upon the photodiode D1. The regulating

- 8 -

means operate by using the photodiode D2 to sample the light output directly from the LED LD1. The photo-current due to the direct light is compared with a reference current and the error compensated by means of 5 negative feedback, using a high-gain operational amplifier U1A.

As shown in Figure 3a, when the interruptor is positioned to permit the maximum amount of light to pass from the LED LD1 to the photodiode D1 the current 10 passing across the photodiode is also at maximum.

Conversely when the interruptor is positioned to permit the minimum amount of light to pass from the LED LD1 to the photodiode D1, as shown in Figure 3c, the current across the photodiode is at a minimum. Figure 3b shows 15 an intermediate position. The current across the photodiode is generally proportional to the position of the interruptor.

A block diagram illustrating the operation of the compensating circuit is shown in Figure 4. The current 20 through the compensating photodiode D2 increases as the amount of light falling on it increases. This change in current is used as negative feedback to the operational amplifier which compares the feedback value to a reference level and amplifies the difference. The 25 inverting configuration of the operational amplifier U1A causes a drop in the output current to the emitter follower reducing the light emitted from the LED LD1. If the amount of light falling on the compensating photodiode D2 is reduced there is a corresponding 30 increase in the output current supplied to the emitter follower and the light emitted from the LED LD1 increases. Thus, the light emitted from the LED LD1 is maintained at a constant level.

The circuit diagram for the present embodiment is 35 shown in Figure 5. The operational amplifier U1A is in an inverting configuration with the compensating photodiode D2 connected in parallel across the input

- 9 -

5 terminals. A transistor Q1 supplies current to the LED LD1; the base is connected to the output of the operational amplifier U1A; the emitter is connected to the LED LD1; and the collector is connected to the supply voltage. The light from the LED LD1 is sampled by the compensating photodiode D2 and this establishes the negative feedback loop. A resistor R16 is connected to the negative input of the operational amplifier U1A and stabilises the output from the operational amplifier U1A, and consequently the LED LD1, at a non-zero 10 operating point. When the circuit is in balance all the photocurrent from D2 flows in the resistor R16. The values shown give a nominal LED current of 20mA at $V_{EE} = -12V$.

15 An operational amplifier U2A is in an inverting configuration with the sensing photodiode D1 connected in parallel across the input terminals. The input into the operational amplifier U2A is determined by the amount of light falling on the sensing photodiode D1. 20 As the amount of light falling on the sensing photodiode D1 increases the current input into the amplifier also increases. The inverted configuration of the amplifier provides for a drop in output if the current input into the negative terminal increases and, conversely, the 25 output increases if the input decreases. A trim circuit 14 comprises a resistor R12 and variable resistor VR1 connected in series with the power supply VEE; this is also connected to the negative input of the operational amplifier U2A and allows the output from the operational 30 amplifier U2A to be adjusted to zero when the photoresistant interruptor 2 is in the middle of its travel range.

35 The output from the operational amplifier U2A is connected to the resistor R1 and capacitor C3, which are connected in parallel, and used as negative feedback. The resistor R1 converts the current output from the amplifier U2A to the required voltage; the capacitor C3

- 10 -

removes interference which would otherwise result at high frequencies. Both of the operational amplifiers U1A and U2A must be FET input, for example TL07X.

5 An operational amplifier U2B and a resistor R3 are connected, in parallel, to the output from the operational amplifier U2A. In this configuration the operational amplifier U2B acts as a signal inverter for the output from the operational amplifier U2A. The inverted signal is then connected in series with a 10 resistor R7 and the positive terminal of an operational amplifier U2D.

The operational amplifier U2D and the resistor R7 are connected, in series, to the inverted output (via the inverting operational amplifier U2B) from the 15 operational amplifier U2A. Similarly, the operational amplifier U2C and a resistor R6 are connected, in series, to the direct output from the operational amplifier U2A. The negative inputs to the operational amplifiers U2C and U2D are connected, in parallel, to a 20 trim circuit 15 and resistors R9 and R8, respectively. The trim circuit 15 comprises a resistor R14 and variable resistor VR2 connected in series with the power supply VEE; this allows the output from the operational amplifiers U2C and U2D to be adjusted to zero when the 25 photo resistant interruptor 2 is at the end of its travel range.

The amplifiers U2C and U2D use identical inverted processing stages to shape the outputs from the amplifiers U2A and U2B to the required output form. The 30 output from the operational amplifier U2C is connected to resistor R4 and a Zener diode D3, which are connected in parallel, and used as negative feedback. The output from the operational amplifier U2D is connected to resistor R5 and a Zener diode D4, which are connected in 35 parallel, and used as negative feedback. The Zener diodes limit the output voltages to around 6V, and - 0.7V.

- 11 -

The simulated transfer characteristic of the processing circuit is shown in Figure 6. Line A represents the output voltage from the operational amplifier U2A as the amount of light projected on it decreases from the maximum to minimum levels. The output voltage from the inverting operational amplifier U2B is represented by Line B. The corresponding output voltages from circuit outputs CV1 and CV2 are represented by Lines C and D, respectively. The measured outputs vary slightly from the simulated results but this is due to discrepancies in the Zener diode model.

Prior to use of the optical potentiometer it may be necessary to first calibrate the unit using trim circuits 14 and 15. To avoid interference with the optics, this procedure should be carried out in subdued light. A signal source is connected to the output channel CV1 and the interruptor is moved to one end of its travel range; the output signal should disappear just before the interruptor reaches the end. If the signal fades too soon, or not at all, then the variable resistor VR2 in the trim circuit 15 should be adjusted. The process should then be repeated for the other output channel CV2 with the interruptor positioned at the other end of its travel range; the variable resistor VR1 in the trim circuit 60 should be adjusted if the output is non-zero. This process should be repeated until both channels fade out completely without excessive 'dead zone' at the ends of travel. The process should not need to be repeated after the initial calibration. If the optical potentiometers were produced in a suitably reliable manner it would not be necessary to calibrate each unit prior to use.

All of the resistors in the circuit are 1% metal film and all the capacitors ceramic disc type. A suitable type of diode D1 and D2 is the Siemens SFH 2030; the Zener diodes D3 and D4 may be 6V2 Zener. The

- 12 -

variable resistors VR1 and VR2 should be 10K preset; all other resistor values are as stated in Figure 5. The power supply should be +/- 12V. The LED LD1 should preferably be a rectangular diffused red type.

5 The design of the circuit for the present invention, as hereinbefore described, has a variety of important features which ensure the maintained accuracy of the operation of the present invention. In particular, the reference and adjustment voltages are
10 all derived from the same supply rail; as a result supply voltage variations will tend to cancel out. Similarly, the sensing and compensating photodiodes D1 and D2 are both of the same type. Any external factors, for example temperature or aging, which may influence
15 the performance of the components have the same effect on both the compensating and sensing photodiodes D1 and D2. Consequently, any variations in external factors do not influence the overall performance of the present invention. The casing for the present invention may further include an opaque enclosure to compensate or
20 exclude the effects of extraneous light on the operation of the present invention. A further embodiment of the present invention may include a rotary bearing on which the photo resistant interruptor 2 is mounted. The photo
25 resistant interruptor 2 would then typically have a radius which increases in size relative to the position of the LED LD1 and the sensing photodiode D1. The internal components of the present invention could, furthermore, have a matt finish to reduce the reflection
30 of light within the apparatus.

The optical potentiometer may typically be used for cross fading. In this application, the outputs from the operational amplifiers U2C and U2D may typically both be connected to two sections of an Analog Devices quad
35 Voltage-Controlled Amplifier chip (not shown) which does the cross fading. The signal processing means firstly convert the photo current from photodiode U2A to a

- 13 -

proportional voltage, by means of a well known transimpedance amplifier. The compliment of this voltage is then derived by means of an inverting amplifier U2B. Two similar non-linear amplifiers, U2C and U2D, distort said proportional voltage and its complement to achieve the desired relationship between knot position and audio volume. The outputs from said non-linear amplifiers control voltage-controlled amplifiers (VCAs). Where there the optical 5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
130
135
140
145
150
155
160
165
170
175
180
185
190
195
200
205
210
215
220
225
230
235
240
245
250
255
260
265
270
275
280
285
290
295
300
305
310
315
320
325
330
335
340
345
350
355
360
365
370
375
380
385
390
395
400
405
410
415
420
425
430
435
440
445
450
455
460
465
470
475
480
485
490
495
500
505
510
515
520
525
530
535
540
545
550
555
560
565
570
575
580
585
590
595
600
605
610
615
620
625
630
635
640
645
650
655
660
665
670
675
680
685
690
695
700
705
710
715
720
725
730
735
740
745
750
755
760
765
770
775
780
785
790
795
800
805
810
815
820
825
830
835
840
845
850
855
860
865
870
875
880
885
890
895
900
905
910
915
920
925
930
935
940
945
950
955
960
965
970
975
980
985
990
995
1000
1005
1010
1015
1020
1025
1030
1035
1040
1045
1050
1055
1060
1065
1070
1075
1080
1085
1090
1095
1100
1105
1110
1115
1120
1125
1130
1135
1140
1145
1150
1155
1160
1165
1170
1175
1180
1185
1190
1195
1200
1205
1210
1215
1220
1225
1230
1235
1240
1245
1250
1255
1260
1265
1270
1275
1280
1285
1290
1295
1300
1305
1310
1315
1320
1325
1330
1335
1340
1345
1350
1355
1360
1365
1370
1375
1380
1385
1390
1395
1400
1405
1410
1415
1420
1425
1430
1435
1440
1445
1450
1455
1460
1465
1470
1475
1480
1485
1490
1495
1500
1505
1510
1515
1520
1525
1530
1535
1540
1545
1550
1555
1560
1565
1570
1575
1580
1585
1590
1595
1600
1605
1610
1615
1620
1625
1630
1635
1640
1645
1650
1655
1660
1665
1670
1675
1680
1685
1690
1695
1700
1705
1710
1715
1720
1725
1730
1735
1740
1745
1750
1755
1760
1765
1770
1775
1780
1785
1790
1795
1800
1805
1810
1815
1820
1825
1830
1835
1840
1845
1850
1855
1860
1865
1870
1875
1880
1885
1890
1895
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
2075
2080
2085
2090
2095
2100
2105
2110
2115
2120
2125
2130
2135
2140
2145
2150
2155
2160
2165
2170
2175
2180
2185
2190
2195
2200
2205
2210
2215
2220
2225
2230
2235
2240
2245
2250
2255
2260
2265
2270
2275
2280
2285
2290
2295
2300
2305
2310
2315
2320
2325
2330
2335
2340
2345
2350
2355
2360
2365
2370
2375
2380
2385
2390
2395
2400
2405
2410
2415
2420
2425
2430
2435
2440
2445
2450
2455
2460
2465
2470
2475
2480
2485
2490
2495
2500
2505
2510
2515
2520
2525
2530
2535
2540
2545
2550
2555
2560
2565
2570
2575
2580
2585
2590
2595
2600
2605
2610
2615
2620
2625
2630
2635
2640
2645
2650
2655
2660
2665
2670
2675
2680
2685
2690
2695
2700
2705
2710
2715
2720
2725
2730
2735
2740
2745
2750
2755
2760
2765
2770
2775
2780
2785
2790
2795
2800
2805
2810
2815
2820
2825
2830
2835
2840
2845
2850
2855
2860
2865
2870
2875
2880
2885
2890
2895
2900
2905
2910
2915
2920
2925
2930
2935
2940
2945
2950
2955
2960
2965
2970
2975
2980
2985
2990
2995
3000
3005
3010
3015
3020
3025
3030
3035
3040
3045
3050
3055
3060
3065
3070
3075
3080
3085
3090
3095
3100
3105
3110
3115
3120
3125
3130
3135
3140
3145
3150
3155
3160
3165
3170
3175
3180
3185
3190
3195
3200
3205
3210
3215
3220
3225
3230
3235
3240
3245
3250
3255
3260
3265
3270
3275
3280
3285
3290
3295
3300
3305
3310
3315
3320
3325
3330
3335
3340
3345
3350
3355
3360
3365
3370
3375
3380
3385
3390
3395
3400
3405
3410
3415
3420
3425
3430
3435
3440
3445
3450
3455
3460
3465
3470
3475
3480
3485
3490
3495
3500
3505
3510
3515
3520
3525
3530
3535
3540
3545
3550
3555
3560
3565
3570
3575
3580
3585
3590
3595
3600
3605
3610
3615
3620
3625
3630
3635
3640
3645
3650
3655
3660
3665
3670
3675
3680
3685
3690
3695
3700
3705
3710
3715
3720
3725
3730
3735
3740
3745
3750
3755
3760
3765
3770
3775
3780
3785
3790
3795
3800
3805
3810
3815
3820
3825
3830
3835
3840
3845
3850
3855
3860
3865
3870
3875
3880
3885
3890
3895
3900
3905
3910
3915
3920
3925
3930
3935
3940
3945
3950
3955
3960
3965
3970
3975
3980
3985
3990
3995
4000
4005
4010
4015
4020
4025
4030
4035
4040
4045
4050
4055
4060
4065
4070
4075
4080
4085
4090
4095
4100
4105
4110
4115
4120
4125
4130
4135
4140
4145
4150
4155
4160
4165
4170
4175
4180
4185
4190
4195
4200
4205
4210
4215
4220
4225
4230
4235
4240
4245
4250
4255
4260
4265
4270
4275
4280
4285
4290
4295
4300
4305
4310
4315
4320
4325
4330
4335
4340
4345
4350
4355
4360
4365
4370
4375
4380
4385
4390
4395
4400
4405
4410
4415
4420
4425
4430
4435
4440
4445
4450
4455
4460
4465
4470
4475
4480
4485
4490
4495
4500
4505
4510
4515
4520
4525
4530
4535
4540
4545
4550
4555
4560
4565
4570
4575
4580
4585
4590
4595
4600
4605
4610
4615
4620
4625
4630
4635
4640
4645
4650
4655
4660
4665
4670
4675
4680
4685
4690
4695
4700
4705
4710
4715
4720
4725
4730
4735
4740
4745
4750
4755
4760
4765
4770
4775
4780
4785
4790
4795
4800
4805
4810
4815
4820
4825
4830
4835
4840
4845
4850
4855
4860
4865
4870
4875
4880
4885
4890
4895
4900
4905
4910
4915
4920
4925
4930
4935
4940
4945
4950
4955
4960
4965
4970
4975
4980
4985
4990
4995
5000
5005
5010
5015
5020
5025
5030
5035
5040
5045
5050
5055
5060
5065
5070
5075
5080
5085
5090
5095
5100
5105
5110
5115
5120
5125
5130
5135
5140
5145
5150
5155
5160
5165
5170
5175
5180
5185
5190
5195
5200
5205
5210
5215
5220
5225
5230
5235
5240
5245
5250
5255
5260
5265
5270
5275
5280
5285
5290
5295
5300
5305
5310
5315
5320
5325
5330
5335
5340
5345
5350
5355
5360
5365
5370
5375
5380
5385
5390
5395
5400
5405
5410
5415
5420
5425
5430
5435
5440
5445
5450
5455
5460
5465
5470
5475
5480
5485
5490
5495
5500
5505
5510
5515
5520
5525
5530
5535
5540
5545
5550
5555
5560
5565
5570
5575
5580
5585
5590
5595
5600
5605
5610
5615
5620
5625
5630
5635
5640
5645
5650
5655
5660
5665
5670
5675
5680
5685
5690
5695
5700
5705
5710
5715
5720
5725
5730
5735
5740
5745
5750
5755
5760
5765
5770
5775
5780
5785
5790
5795
5800
5805
5810
5815
5820
5825
5830
5835
5840
5845
5850
5855
5860
5865
5870
5875
5880
5885
5890
5895
5900
5905
5910
5915
5920
5925
5930
5935
5940
5945
5950
5955
5960
5965
5970
5975
5980
5985
5990
5995
6000
6005
6010
6015
6020
6025
6030
6035
6040
6045
6050
6055
6060
6065
6070
6075
6080
6085
6090
6095
6100
6105
6110
6115
6120
6125
6130
6135
6140
6145
6150
6155
6160
6165
6170
6175
6180
6185
6190
6195
6200
6205
6210
6215
6220
6225
6230
6235
6240
6245
6250
6255
6260
6265
6270
6275
6280
6285
6290
6295
6300
6305
6310
6315
6320
6325
6330
6335
6340
6345
6350
6355
6360
6365
6370
6375
6380
6385
6390
6395
6400
6405
6410
6415
6420
6425
6430
6435
6440
6445
6450
6455
6460
6465
6470
6475
6480
6485
6490
6495
6500
6505
6510
6515
6520
6525
6530
6535
6540
6545
6550
6555
6560
6565
6570
6575
6580
6585
6590
6595
6600
6605
6610
6615
6620
6625
6630
6635
6640
6645
6650
6655
6660
6665
6670
6675
6680
6685
6690
6695
6700
6705
6710
6715
6720
6725
6730
6735
6740
6745
6750
6755
6760
6765
6770
6775
6780
6785
6790
6795
6800
6805
6810
6815
6820
6825
6830
6835
6840
6845
6850
6855
6860
6865
6870
6875
6880
6885
6890
6895
6900
6905
6910
6915
6920
6925
6930
6935
6940
6945
6950
6955
6960
6965
6970
6975
6980
6985
6990
6995
7000
7005
7010
7015
7020
7025
7030
7035
7040
7045
7050
7055
7060
7065
7070
7075
7080
7085
7090
7095
7100
7105
7110
7115
7120
7125
7130
7135
7140
7145
7150
7155
7160
7165
7170
7175
7180
7185
7190
7195
7200
7205
7210
7215
7220
7225
7230
7235
7240
7245
7250
7255
7260
7265
7270
7275
7280
7285
7290
7295
7300
7305
7310
7315
7320
7325
7330
7335
7340
7345
7350
7355
7360
7365
7370
7375
7380
7385
7390
7395
7400
7405
7410
7415
7420
7425
7430
7435
7440
7445
7450
7455
7460
7465
7470
7475
7480
7485
7490
7495
7500
7505
7510
7515
7520
7525
7530
7535
7540
7545
7550
7555
7560
7565
7570
7575
7580
7585
7590
7595
7600
7605
7610
7615
7620
7625
7630
7635
7640
7645
7650
7655
7660
7665
7670
7675
7680
7685
7690
7695
7700
7705
7710
7715
7720
7725
7730
7735
7740
7745
7750
7755
7760
7765
7770
7775
7780
7785
7790
7795
7800
7805
7810
7815
7820
7825
7830
7835
7840
7845
7850
7855
7860
7865
7870
7875
7880
7885
7890
7895
7900
7905
7910
7915
7920
7925
7930
7935
7940
7945
7950
7955
7960
7965
7970
7975
7980
7985
7990
7995
8000
8005
8010
8015
8020
8025
8030
8035
8040
8045
8050
8055
8060
8065
8070
8075
8080
8085
8090
8095
8100
8105
8110
8115
8120
8125
8130
8135
8140
8145
8150
8155
8160
8165
8170
8175
8180
8185
8190
8195
8200
8205
8210
8215
8220
8225
8230
8235
8240
8245
8250
8255
8260
8265
8270
8275
8280
8285
8290
8295
8300
8305
8310
8315
8320
8325
8330
8335
8340
8345
8350
8355
8360
8365
8370
8375
8380
8385
8390
8395
8400
8405
8410
8415
8420
8425
8430
8435
8440
8445
8450
8455
8460
8465
8470
8475
8480
8485
8490
8495
8500
8505
8510
8515
8520
8525
8530
8535
8540
8545
8550
8555
8560
8565
8570
8575
8580
8585
8590
8595
8600
8605
8610
8615
8620
8625
8630
8635
8640
8645
8650
8655
8660
8665
8670
8675
8680
8685
8690
8695
8700
8705
8710
8715
8720
8725
8730
8735
8740
8745
8750
8755
8760
8765
8770
8775
8780
8785
8790
8795
8800
8805
8810
8815
8820
8825
8830
8835
8840
8845
8850
8855
8860
8865
8870
8875
8880
8885
8890
8895
8900
8905
8910
8915
8920
8925
8930
8935
8940
8945
8950
8955
8960
8965
8970
8975
8980
8985
8990
8995
9000
9005
9010
9015
9020
9025
9030
9035
9040
9045
9050
9055
9060
9065
9070
9075
9080
9085
9090
9095
9100
9105
9110
9115
9120
9125
9130
9135
9140
9145
9150
9155
9160
9165
9170
9175
9180
9185
9190
9195
9200
9205
9210
9215
9220
9225
9230
9235
9240
9245
9250
9255
9260
9265
9270
9275
9280
9285
9290
9295
9300
9305
9310
9315
9320
9325
9330
9335
9340
9345
9350
9355
9360
9365
9370
9375
9380
9385
9390
9395
9400
9405
9410
9415
9420
9425
9430
9435
9440
9445
9450
9455
9460
9465
9470
9475
9480<br

- 14 -

CLAIMS

1. An optical potentiometer comprising a light source, a light detecting means, a linearly movable control member, and light blocking means disposed between the light source and light detecting means which is movable to selectively determine the amount of light from the source which is received by the light detecting means, the position of the light blocking means being controlled by the linearly movable control member, characterised in that the light blocking means moves transversely with respect to the path of light from the light source to the light detecting means and has an operative edge which is profiled to adjust the amount of light passing from the light source to the light detecting means in accordance with the transverse position of the light blocking means.
2. An optical potentiometer as claimed in claim 1, characterised in that the light blocking means is in the form of a plate having an aperture which defines the operative edge.
3. An optical potentiometer as claimed in claim 1, characterised in that the light blocking means is in the form of a plate having a free edge defining the operative edge.
4. An optical potentiometer as claimed in claim 3, characterised in that the operative edge is inclined in the direction of movement of the light blocking means.
5. An optical potentiometer as claimed in claim 4, characterised in that it comprises a base, a longitudinally extending support provided on the base, a slider mounted on the support for longitudinal movement, and a control member on an outer lateral edge of the

- 15 -

slider, the inner lateral edge of the slider being opaque and tapering in the longitudinal direction so as to define the light blocking means and operative edge, the light source being disposed on one side of the 5 slider adjacent the inner lateral edge and the light detecting means being aligned with the light source and on the other side of the slider.

10 6. An optical potentiometer as claimed in claim 5, characterised in that the light source, light detecting means and light blocking means are within a light proof housing.

15 7. An optical potentiometer as claimed in claim 5, characterised in that the light source is a light emitting diode.

20 8. An optical potentiometer as claimed in claim 1, characterised in that there is provided second light detecting means arranged to detect light from the light source without the intervention of the light blocking means, and compensating means which maintains the output of the light source substantially stable in accordance with a signal provided by the second light detecting 25 means.

30 9. An optical potentiometer as claimed in claim 8, characterised in that the compensating means adjusts the output by means of negative feedback.

10. An optical potentiometer as claimed in claim 9, characterised in that the second light detecting means is substantially identical to the first light detecting means.

35 11. An optical potentiometer comprising a base, a longitudinally extending support provided on the base, a

- 16 -

slider mounted on the support for longitudinal movement, a control member on an outer lateral edge of the slider, the inner lateral edge of the slider being opaque and tapering in the longitudinal direction, a light source on one side of the slider adjacent the inner lateral edge, and light detecting means aligned with the light source and on the other side of the slider, so that longitudinal movement of the slider under the action of the control member selectively controls the amount of light reaching the light detecting means from the light source.

12. An optical potentiometer as claimed in claim 11, characterised in that second light detecting means is positioned on said one side of the slider to receive light from the light source without the intervention of the slider, and in that compensating means are provided to control the output of the light source in accordance with a signal from the second light detecting means.

13. An optical potentiometer comprising a light source, first light detecting means, a movable control member, and light blocking means disposed between the light source and the first light detecting means which selectively determines the amount of light from the source which is received by the first light detecting means in accordance with the position of the movable control member, characterised in that there is provided second light detecting means arranged to detect light from the light source without the intervention of the light blocking means, and compensating means which maintains the output of the light source substantially stable in accordance with a signal provided by the second light detecting means.

14. An optical potentiometer comprising an armature, support means, and one or more rotary or linear bearings

- 17 -

upon which the armature may translate or rotate relative to the support means, also comprising light emitting and light detecting means, both of said means being attached to the support means and arranged such that the light from the light emitting means falls upon the light detecting means, also means by which the motion of the armature regulates the amount of light from the light emitting means which falls on the light detecting means in a progressive manner, also means to exclude extraneous light.

1/5

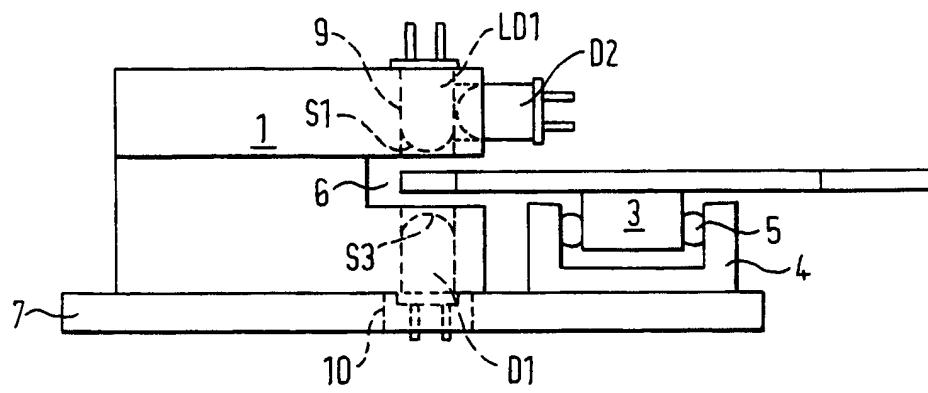


FIG. 1

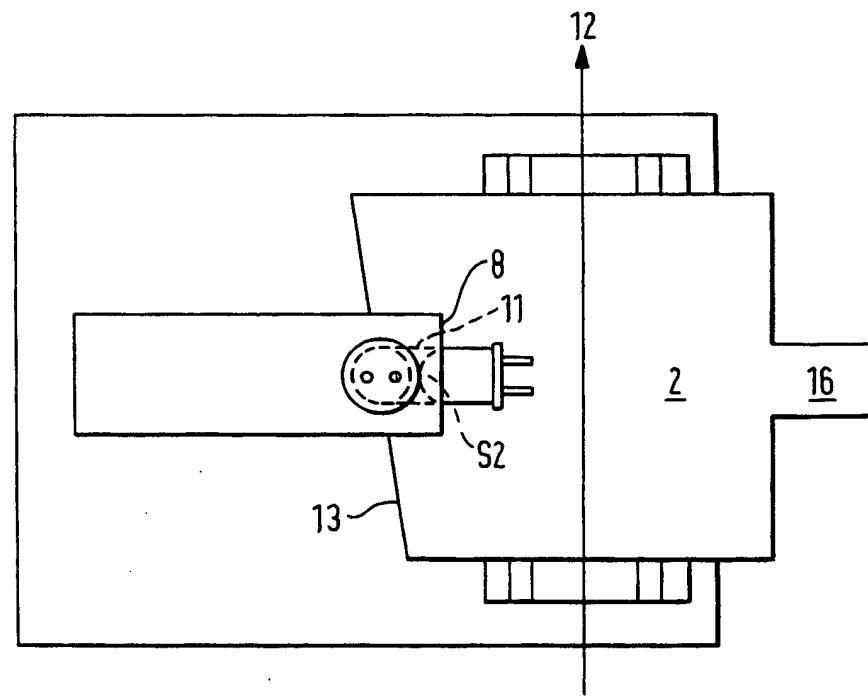
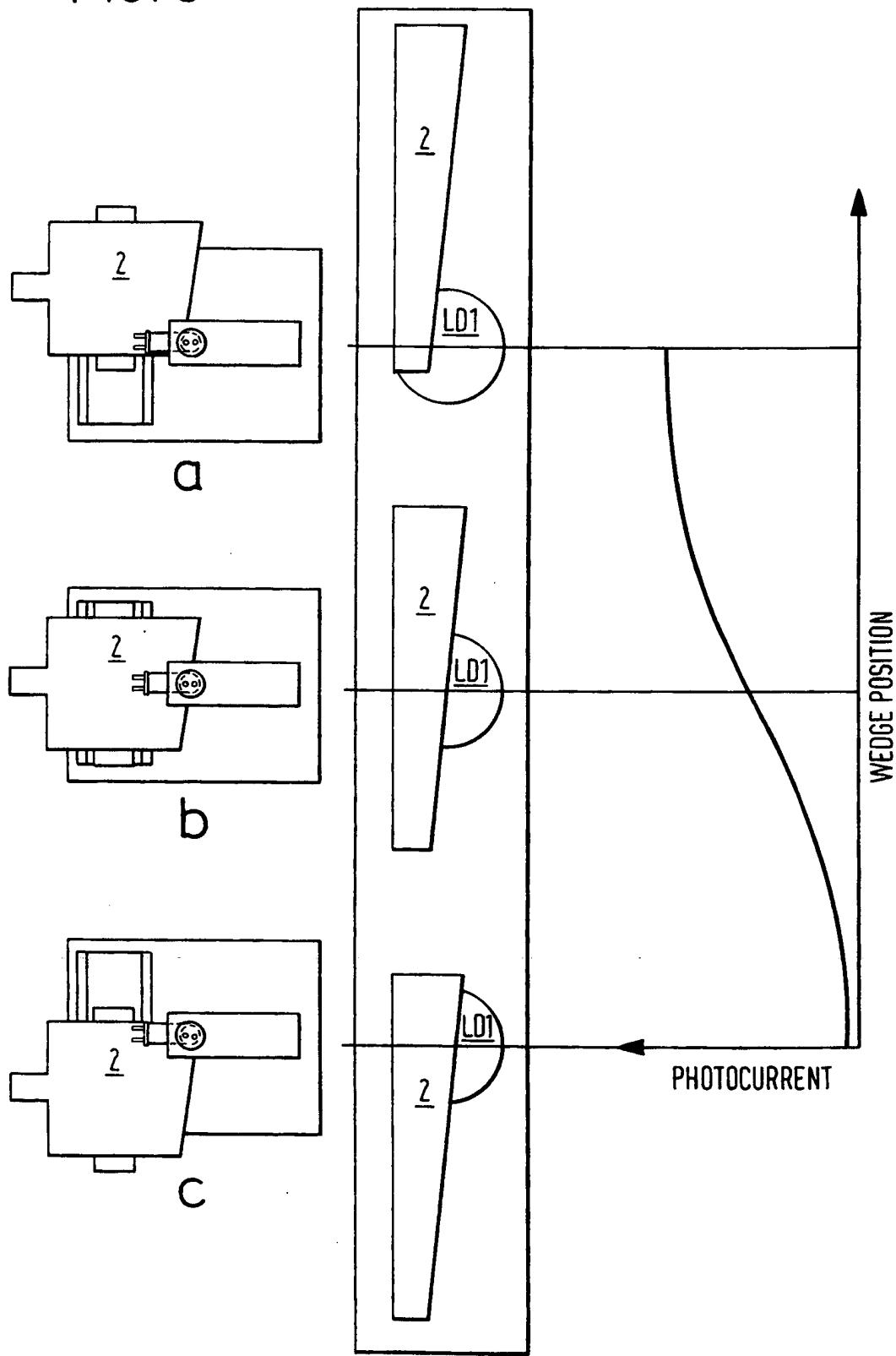


FIG. 2

2/5

FIG. 3



3 / 5

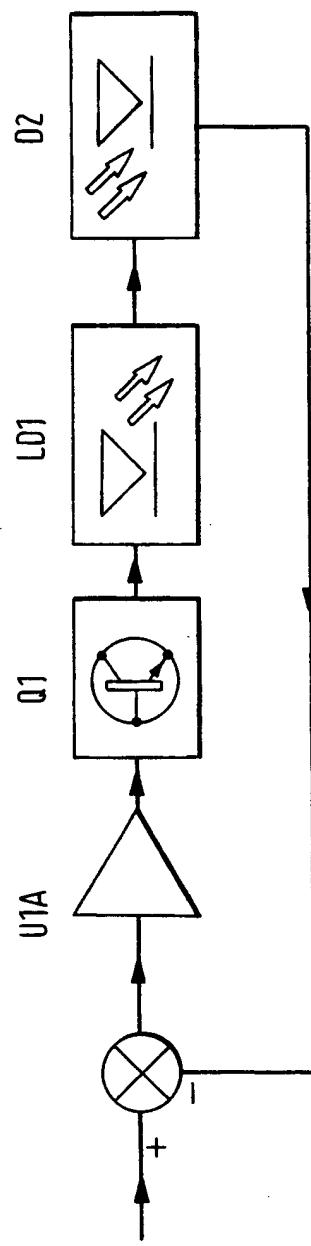
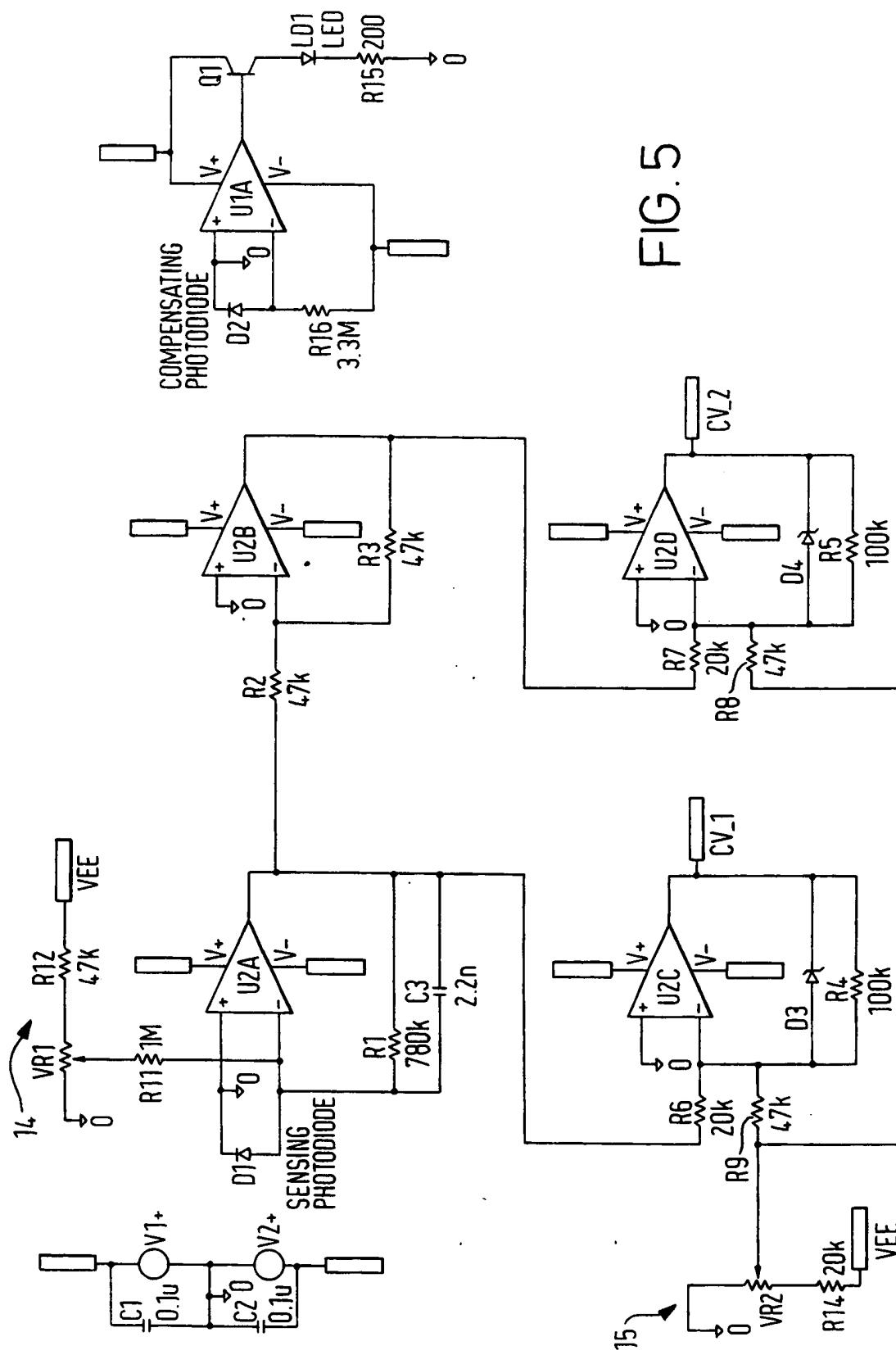


FIG. 4

4/5



5/5

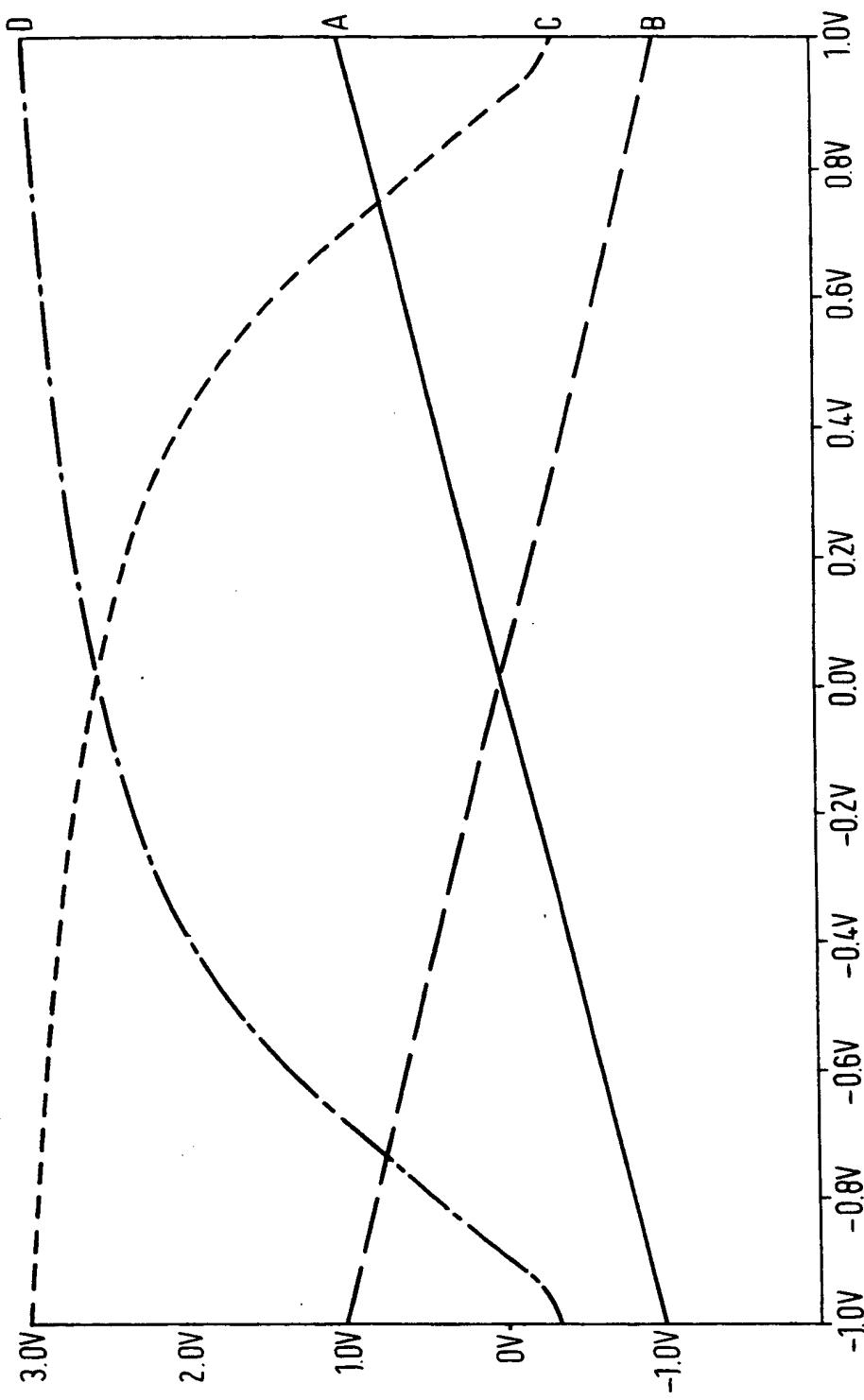


FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/01725

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01L31/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched: ~~Search done by classification symbols~~
IPC 6 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 96 08042 A (BLOEMEN JOOST LODEWIJK KAREL F) 14 March 1996 (1996-03-14) the whole document ---	14
A	WO 95 34082 A (SANTHA ANDRAS) 14 December 1995 (1995-12-14) claims 1-5; figure 2 ---	1-7, 11
A	EP 0 005 548 A (HEIMANN GMBH) 28 November 1979 (1979-11-28) page 9, line 17 - line 32; figure 7 ---	1
A	US 5 285 085 A (ONISHI MINORU) 8 February 1994 (1994-02-08) column 7, line 55 - column 8, line 48; figure 5 ---	1, 2 -/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

6 September 1999

14/09/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Acco, S

1

INTERNATIONAL SEARCH REPORT

national Application No
PCT/GB 99/01725

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 011, no. 129 (P-570), 23 April 1987 (1987-04-23) & JP 61 271414 A (MITSUBISHI ELECTRIC CORP), 1 December 1986 (1986-12-01) abstract -----	1, 8-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

national Application No

PCT/GB 99/01725

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
WO 9608042	A	14-03-1996	NL	9401441 A	01-04-1996
WO 9534082	A	14-12-1995	AU	7081694 A	04-01-1996
EP 0005548	A	28-11-1979	DE	2822502 A	29-11-1979
			JP	54153267 A	03-12-1979
			US	4283702 A	11-08-1981
US 5285085	A	08-02-1994		NONE	
JP 61271414	A	01-12-1986		NONE	

